

**CONTAMINANT TRANSPORT
BELOW MSW LANDFILLS USING
(HERMITIAN) GREEN ELEMENT METHOD**

by

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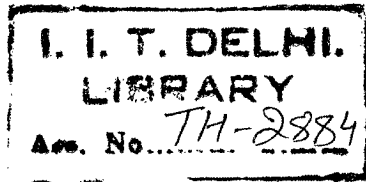
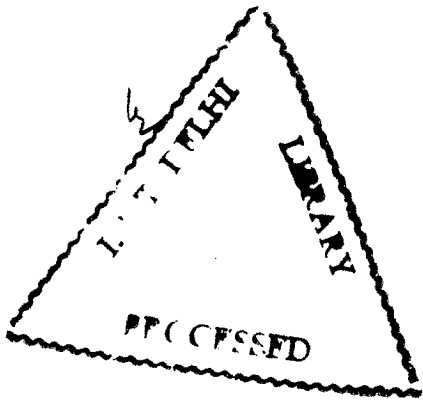
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Certificate

This is to certify that the thesis entitled, "**Contaminant Transport below MSW Landfills using (Hermitian) Green Element Method**" being submitted **by Lalith Pinto Jayawardena** to the Indian Institute of Technology, Delhi for the award of the degree of **Doctor of Philosophy** is a bona-fide record of research work carried out by him under my supervision and guidance. The thesis work, in my opinion, has reached the requisite standard fulfilling the requirement for the degree of the **Doctor of Philosophy**.

The results contained in this thesis have not been submitted, in part or full, to any other University or Institute for the award of any degree or diploma.



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Abstract

Natural clay deposits and compacted clay liners are used as landfill barriers and the regulatory organisations often specify some guidelines to decide the minimum thickness of the compacted clay liner so that it performs satisfactorily. There is however no consensus on what an appropriate minimum thickness ought to be due to difficulties encountered while analysing soil liners. In the present study, an attempt has been made to estimate minimum thickness of barriers for conservative and non-conservative contaminants.

The governing equation for the one-dimensional model includes the effects of advection, dispersion, adsorption and decay of the contaminant in saturated soils. The one-dimensional model is solved by a hybrid numerical technique (Green Element Method) using Hermitian interpolation functions. The model is first validated for chlorides and dissolved organic carbon at a landfill site and the simulated spatial and temporal variation of the contaminants is found to match well with the observed values.

Later, an analysis is conducted taking a finite mass of the pollutant as the top boundary and the maximum relative concentration of the contaminant is determined as it moves down. On the basis of these results, design charts are produced to determine the minimum thickness of the liner for various equivalent leachate heights and Darcy velocity when flow is in the downward direction.

A study is also conducted to determine the impact of flow in the upward direction (hydraulic trap) where diffusion becomes more prominent at high Darcy velocity, however, dispersion becomes important when the flow direction is reversed.

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